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A HUMAN RESOURCES PLANNING MODEL FOR MAURITANIA

Version 2

June 1983

by

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INTEGRATED POPULATION-DEVELOPMENT PLANNING
Project Number AID/DSPE-C-0062

Under Contract to

Policy Development Division
Office of Population
Bureau for Technology and Science
United States Agency for International Development
Department of State
Washington, DC 20523

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A HUMAN RESOURCES PLANNING MODEL FOR MAURITANIA--VERSION 2

1. Introduction

This report describes the second version of an economic-demographic model for Mauritania developed by RTI/IPDP.[1] As indicated below, further work will be done by RTI/IPDP in collaboration with DEP/MEF/RIM[2] to make the model more suitable to the specific needs and situation of Mauritania as the need arises.

Effective development planning requires a clear understanding of the interactions and linkages between economic, social and demographic factors in the development process. In particular, human resources planning must be preceded by a delineation of how the form and pace of development will alter and be altered by changes in the demographic factors: fertility, mortality and migration. The demographic composition and changes taking place in a society profoundly affect levels of consumption and production, labor force participation, demands for health, education and other social services. The specification of an economic-demographic model allows planners to comprehend the complex network of direct and indirect relationships between the variables relevant to alternative development policies. While a formal, empirical model is not a substitute for human judgment, a properly validated model can serve a critical complementary role by demonstrating multi-faceted interactions and exposing underlying assumptions to criticism and revision.

There are two potential uses to which computer simulation models of population and development can be put: planning and policy analysis. Planning

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[1] Research Triangle Institute, Integrated Population-Development Program.

[2] Direction des Etudes et de la Programmaion, Ministere de l'Economie et des Finances, Republique Islamique de la Mauritanie.

briefly, consists of specifying a consistent set of targets for a specified list of variables so as to achieve some pre-specified goals. Since computer models are particularly well suited to keeping track of a large number of variables and since a large proportion of these models is accounting relationships, they are potentially valuable for planning. For example, an anticipated drop in the birth rate which is not coordinated with a program to increase the number of teachers in proportion to an expected increase in school enrollment rates may result in a surplus of teachers. A model can serve to alert planners to the size of this potential problem.

Policy analysis, by contrast, involves determining the impact of changes in one variable upon another. Policy analysis, in fact, often preceeds planning. It involves analysing not only direct effects but also indirect effects and feedbacks. Here again, computer simulation models are of potential value since variables are linked together not only directly through behavioral equations but also indirectly through the above-mentioned accounting relationships. The endogenizing of many variables (for example, fertility) which in earlier approaches were left exogenous, allows planners and policy-makers alike to recognize that programs designed explicitly to have an impact in one area may have an effect in another.

The ideal model would be well suited for both policy analysis and planning. However, the structure and parameters of actual models determine that they are often more appropriate for one use than another. A policy analysis model may include a myriad of linkages, feedbacks and endogenous variables. The accuracy of the time paths of the model's variables is not as important as the qualitative information gained by manipulating policy variables in the model. For example, a policy model might answer the question: Will the introduction

of a new water system in a rural area affect the growth rate of the population? Because of this emphasis on qualitative information, the parameter values are not as important as in planning models, which, are more concerned with quantitative information. A typical question addressed by a planning model, might be: What will be the number of primary school students in 1995?

The present model is seen as a planning model. In its present version, there are fewer behavioral equations than in the preliminary version[1]. The decision to drop these equations, many of which were based on international cross-section data, was made in an effort to make the structure and parameters of the model conform as closely as possible to the situation in Mauritania. As a result there are more fixed coefficients in the model than originally. Of course it is always possible to change these coefficients as new information comes to light, or if the planner wants to experiment with his own estimates; this is one of the advantages of computer simulation models.

It should be emphasized that because of this fixed structure, the model shows the time paths of the variables with no change in that structure. In reality it is to be expected that structural changes and adjustments take place. For example, in the present model the percentage of uneducated workers in the desired employment of the mining industry does not change over time. Yet as the skill mix of the labor force changes, we would expect an adjustment in the skill mix of desired employment in the real world. While the present model does not actually simulate that adjustment, it does indicate to the planner where adjustments are likely to occur.

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[1]See: R. Scott Moreland, "An Integrated Population and Development Planning Model for Mauritania: Preliminary Version", RTI/IPDP, Sept. 1981.

The Human Resources Planning Model consists of three submodels:

1. The Demographic Submodel tracks the population by age, sex, and location. It also gives information on demographic vital rates. The demographic submodel is linked to the other two models.

2. The Education/Manpower/Employment Submodel gives the number of enrolled students in each class in primary, secondary general and secondary technical school. A crude measure of traditional education is also included. In addition, the required number of teachers and classrooms is also calculated. The education structure of the labor force is also calculated in this submodel. Employment by sector and education level as well as unemployment by education are also calculated here.

3. The Nutrition/Livestock/Health Submodel gives the calorie and food requirements (by type of food) of the nomad, urban and rural sedentary populations. It calculates the herd size of camels, goats, cattle and sheep as well as food byproducts from these animals. It also gives the WHO standard requirements for health personnel.

The time frame of the model is seen as ten to fifteen years. This is relatively short for a demographic model, but long for a planning model. In order for changes in demographic variables to have an appreciable impact, a period of at least 10-15 years is necessary. However, since the planning cycle is typically 5-15 years, it was felt that extending the time frame of the model further than 15 years would have had dubious value. One solution to this would be to rebuild the economic model as a longer term one which is capatible with the present shorter term model. In any case for most planning applications, a 10-15 year horizon is probably adequate.

2. Demographic Submodel

Structure

The demographic subsystem is concerned with tracking the population in each period by age, sex, location, education level and labor force participation. "Location" in this context means urban sedentary, rural sedentary, and

nomad. The demographic subsystem is the core of the human resources planning model since the outputs of virtually all the subsystems depend in one way or another on the demographic structure. Because of this, particular care has must be taken in initializing this system as noted later.

In the preliminary version of the Mauritania Human Resources Model,[1] the demographic submodel drew heavily on the demographic subsystem of the BACHUE-International model developed by RTI/IPDP population economist R. Scott Moreland.[2] In that model, many of the key demographic variables were endogenous and linked, particularly through income, with the economic submodel. The linkage between economic and socioeconomic variables was made with regression equations estimated from international cross-section data. There is now ample reason to believe that demographic phenomena in many developing countries are affected by changes in socio-economic phenomena, particularly in the long term. The common theory underlying the endogeneity of many demographic rates is that decisions about having children, entering the workforce or relocating are made, at least in part, on the basis of individual cost-benefit calculations reflecting constraints on the use of one's time.

While it is thus theoretically desirable to have endogenous demographic variables, in the present model all are exogenous. There are two reasons for this. Firstly, the time span of the model is ten to fifteen years. With the exception of migration rates, changes in fertility and mortality have very little effect on the age distribution of the population before fifteen years

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[1]See Moreland, "An Integrated Population and Development Planning model for Mauritania," RTI/IPDP, September 1981.

[2]"An Economic-Demographic Model for Developing Countries: BACHUE-International," ILO/WEP, working paper No. 70, 1978.

so it is arguable that incorporation of equations to predict demographic variables would gain little in terms of accuracy. Secondly, there are virtually no Mauritanian data with which to estimate the quantitative relationship between the various socio-economic and demographic variables. As will become clear subsequently, there is even a very real problem in knowing what the levels of many demographic variables are. An alternative is to use international cross-section data but this requires the assumption that there is a common underlying structure between the variables in question for the countries in the international sample and that Mauritania is a part of that structure. This is a tentative assumption which seems more appropriate in the context of a policy analysis model than in the context of a planning model.

Population Projection

Starting with an initial population by age, sex and spatial distribution, it is relatively straightforward to project the population forward in time once fertility, mortality and migration rates are known. This is so since the population is divided into one year age groups so that each year, each cohort matures to the next highest cohort.

The population at age "zero" (or the first cohort) consists of people born during the first period with an appropriate sex ratio (SR) applied:

$$\text{(i) age 0} \quad : \quad P^{t}_{1,L,0} = (SR) \cdot FR_L \cdot \sum_{K=15}^{49} P^{t-1}_{S,L,K} \cdot f_k \qquad L=1, \ldots, 3$$

and

$$P^{t}_{2,L,0} = P^{t}_{1,L,0} \cdot (1-SR)$$

when:

FR_L = the total fertility rate for location L,

f_k = proportion of lifetime births occurring at age k

SR = the proportion total births which are female

$P^t_{S,L,K}$ = the population of time t, sex S, location L, and age K (S=1: females; S=2: males)

Between birth and entry into the 65+ (open-ended) interval, people maturate from one cohort to another, subject to the survival probabilities ($S^t_{S,K}$), obtained from the Coale-Demeny tables corresponding to the given level of life expectancy. Location changes due to migration are accounted for here as well via migration probabilities, $p_{i,L,K}$.

(ii) Ages 1-65:

$$P^t_{S,L,K} = S^{t-1}_{S,K-1} \sum_{i=1}^{3} P^{t-1}_{S,i,K-1} \; p_{i,L,K} \qquad \begin{array}{l} S=1,2 \\ L=1,2,3 \\ K=1,\ldots.65 \end{array}$$

where:

$S^{t-1}_{S,K-1}$ = the probability of surviving from age K-1 to K for sex S in period t-1.

$P_{i,L,K}$ = the probability of migrating from region i to L for age K.

Note that,

$$S_{S,K} = f(EO, CDMLT)$$

where CDMLT is the Coale-Demeny model life table of which $S_{S,K}$ is one column. Lastly the open-ended interval is calculated with an assumption of no migration:

(iii) age 65+ (open-ended inverval)

$$P^t_{S,L,65+} = (P^{t-1}_{S,L,64} + P^{t-1}_{S,L,65+}) \cdot S^{t-1}_{S.65+} \qquad \begin{array}{l} S=1,2 \\ L=1,2,3 \end{array}$$

Internal Migration

Internal migration has been an important phenomena in developing countries in general and in Mauritania in particular. In the present version of the model migration among the three principal population groups is handled by use of a matrix of migration probabilities, π, where each element of the matrix, $p_{i,j}$ represents the probability of someone in location i moving to location j. In particular, the matrix takes the form:

FROM \ TO	1	2	3
Location 1	p_{11}	p_{12}	p_{13}
2	p_{21}	p_{22}	p_{23}
3	p_{31}	p_{32}	p_{33}

where location 1 is urban sedentary, 2 is rural sedentary and 3 is nomadic. Note that the diagonal elements, p_{ii} represent the probability of individuals remaining in their present location. Also, the row probabilities must sum to one:

$$\sum_{j=1}^{3} p_{i,j} = 1 \qquad i=1,2,3$$

As certain age groups are more prone to migrate than others we have assumed that the elements of π refer to the probabilities of adults ages 15-34. People younger than 15 or older than 34 have migration probabilities which are a fixed proportion of π.

At the present time the elements of π are constant and exogenous. Eventually it is hoped to endogenize some of these rates to make them responsive to relative economic opportunities in originating and destination locations.

Initialization and Parameters

The demographic variables needed to run the model are the population by age, sex, and location, general fertility rates by location, female life expectancy at birth and the migration probabilities. Because of the central role played by the demographic variables in the model it was felt that the initial values of the population should be as consistent as possible. In the present version, we have taken the 1977 census data as reported in RAMS Statistical Appendix. However, there are several inconsistencies in this data and it is hoped to produce adjusted figures at a later date.

Projection of the Mauritanian population by three groups - urban, rural sedentary and nomadic - requires taking migration between the groups into account. Unfortunately, very little statistical information on migration is available. However, some inter-group rates can be indirectly calculated from census data. The tentative nature of these rates should be emphasized since they rest on several tentative assumptions.

We start by finding gross flows of urban, rural sedentary and nomad migrants, between 1965 and 1977. Table 1 presents the data base used for these calculations with notes on sources.

Adjusted Urban 1977	=	376,081
Expected Urban 1977	=	114,226
Difference	=	+261,855
Adjusted Rural 1977	=	610,506
Expected Rural 1977	=	222,400
Difference		+388,106
Adjusted Nomad 1977	=	458,652
Expected Nomad 1977	=	222,500
Difference	=	-670,240

The difference, or residual, between the urban and rural positive differences and the nomad negative difference is either error or international migration: 649,961-670,240 = 20,279.

Assuming that these 20,279 people represent international migrants, we can distribute them proportionately according to the 1965 and 1977 populations of 1,041,150 and 1,445,239, which had the following proportions of urban, rural and nomad:

	1965	1977	Average
Urban	.08	.26	.17
Rural	.15	.42	.29
Nomad	.77	.32	.54

We can find the gross migration flows (M) with no international migration as follows:

	1977 Actual	1977 Urban with International	1977 Expected	M
Urban:	376,081 + (.17)(20,279)	= 379,528	- 114,226	= +265,302
Rural:	610,506 + (.29)(20,279)	= 616,387	- 222,400	= +393,987
Nomad:	458,652 + (.54)(20,279)	= 469,603	- 1,128,892	= -659,289
				0

The special sample census of nomads which was part of the 1976/7 Census enables us to estimate the proportion of nomad migrants selecting an urban destination out of the total nomad migrants as .2453, (i.e., 1.3/(1.3 + 4.0)) or, alternatively, the ratio of nomad migrants preferring an urban destination to those preferring a rural one (k) is .325, (i.e., 1.3/4.0).

Defining:

$$Mu = Mnu + Mru - Mun - Mur$$
$$Mr = Mnr + Mur - Mrn - Mru$$
$$Mn = Mun + Mrn - Mnu - Mnr$$

Where:

M = migrant flow
u = urban
r = rural
n = nomad

and Mnu = nomad to urban migrant flow, etc., we then assume:

Mun = 0
Mur = 0
Mrn = 0

The assumption of zero migration in these three categories is based on lack of information and the observation that these flows are usually not significant.

We find r the 1965-1977 intercensal rate of growth for nomads using:

$$1 + r = \sqrt[n]{\frac{P_n}{P_o}}$$

and

$$\log (1 + r) = \frac{\log \left(\frac{P_n}{P_o}\right)}{n}$$

Where Pn is the 1977 Census population, adjusted for reporting errors and international migration;

Po is the 1965 Census population

n is the intercensal interval

r is the intercensal rate of natural increase.

Using the formula above and substituting the appropriate numbers from Table 1, the nomad population can be calculated to have grown at an annual average rate of .0436. Assuming the rate of natural increase of .0289 derived from the adjusted 1977 Census population is also an average rate, we can say that the average annual rate of net migration was -.0436 -.0289 = -.0725, i.e., there is a net outflow.*

We then have the following system:

1. Mu = Mnu + Mru
2. Mr = Mnr - Mru
3. Mn = -(Mnu + Mnr)
4. Mnu = (k)(Mnr)

From 1 and 2:

5. $Mr = Mnr - Mru = Mnr - (Mu - Mnu)$

From 4 and 5:

$$Mr = Mnr - (Mu - kMnr) = (1 + k)\ Mnr - Mu$$

or

$$Mnr = \frac{M_r + M_u}{1 + k} = \frac{659,289}{1.325} = 497,577$$

then Mnu = 161,712

and Mru = 103,590

Since the proportion of nomad migrants choosing an urban destination is .2453, we estimate the nomad to urban migration rate (Mnu) as:

$$Mnu = (.2453)(.0725) = .0178$$

and the nomad to rural sedentary migration rate as Mnr = .0725 - .0178 = .0547.

Since the other rates are assumed to be zero, we have only to estimate the rural sedentary to urban migration rate relative to the rural sedentary population. Given a net migrant flow into rural sedentary from nomad of 492,577 and a 1977 expected rural sedentary population (projected by a natural rate of increase) of 222,400, then the implication is that the 1977 rural sedentary population would have been 222,400 + 497,577 = 719,977 if there had been no rural sedentary to urban migration. Comparing this estimate (719,977) to the 1977 actual rural sedentary population adjusted for international migration (616,387) implies that there were 103,590 net rural to urban migrants during the twelve-year intercensal period.

Calculating an intercensal growth rate for the rural sedentary population based on the 1965 population and the 1977 rural population if there had been no out-migration, we find an average annual rate of .1347. Since the actual rate is .1201, this implies an average annual rate of out-migration of .1347 - .1201 = .0146.

Table 1.

Database for Migration Calculations

Name	Number		Source
Adjusted Urban Population 1976/1977	376081	(A)	"Mauritanian Population Distribution by Age and Sex," Allen 1982
Adjusted Rural Sedentary Population 1976/7	610506	(A)	
Adjusted Nomad Population 1976/7	458652	(A)	
Enumerated Urban Population 1964/5	81150	(C)	
Enumerated Rural Sedentary Population 1964/5	158000	(C)	SEDES (Sample Census)
Enumerated Nomad Population 1964/5	802000	(C)	
Rate of Natural Increase	2.89%	(A)	
Expected 1977 Urban Population	114226	(D)	Projected from 1965 population at .0289 rate
Expected 1977 Rural Sedentary Population	222400	(D)	
Expected 1977 Nomad Population	1128892	(D)	
Adjusted 1977 Urban Population plus international migrants	379528	(E)	

Table 1.

Database for Migration Calculations
(Continued)

Name	Number		Source
Adjusted 1977 Rural Sedentary Population plus international migrants	616387	(E)	Table of this report calculated for the purpose of determining internal migration flows
Adjusted 1977 Nomad Population plus international migrants	469603	(E)	
Percent of Nomads migrating to urban areas 1976/7	1.3%*	(B)	"Annotated Statistical Compendium," RAMS 1981
Percent of Nomads joining the rural sedentary population 1976/7	4.0%*	(B)	

*This was based on replies to a Census question: "Do you plan to move and settle in the next year, and if so, where?"

The following matrix presents the calculated and assumed migration rates used in the model:

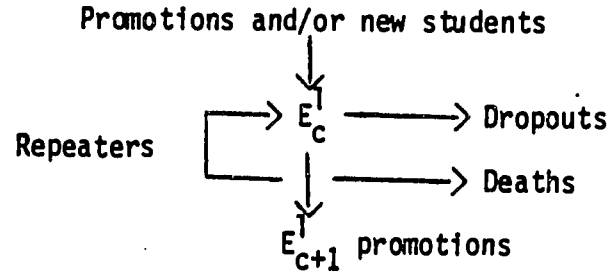
FROM/TO	URBAN	RURAL	NOMAD
Urban	1.0000	0.0000	0.0000
Rural	0.0146	0.9854	0.0000
Nomad	0.0178	0.0547	0.9275

3. Education/Manpower/Employment Submodel

Structure

The educational system in Mauritania can be classified into public and private sectors. Within the public sector there are primary, secondary, and higher education schools. In addition, there are other publicly supported centers of learning which differ structurally from the aforementioned, such as the "Centre de Formation Professionnelle Marmadou Touré." In the private sector can be classified traditional, Koranic education as well as a number of small, vocationally oriented "Centres de Formation." In modelling the educational system for the Human Resources Model, we chose to focus on the formal public sector. In particular the education submodel keeps track of enrollment in primary, secondary general, and secondary technical schools. A crude measure of the traditional student population is also given. Unfortunately, we were unable to keep track of enrollment and graduation from the many vocationally-oriented training schools due to lack of data. Nevertheless, the submodel covers the largest and most important elements of the Mauritanian education system.

The submodel keeps track of current enrollment at each level, the dropouts at each level, and graduates from each school type. A typical cell in the model is represented schematically below:



Each cell corresponds to a class level. Current enrollment is thus influenced by the rate of promotion from lower level classes, the number of repeaters, mortality and the dropout rate. In equation form enrollment is given by:

$$E^1_{ct} = (E^1_{c-1,\xi-1}) \cdot (1 - r^1_{c-1} - \psi^1_{c-1}) \cdot SR_{c-1} + (E^1_{c,\xi-1}) \cdot r^1_c \cdot SR_c$$

where,

$E^1_{c,t}$ = enrollment in class c, at level 1 at time t

r^1_c = the repeat rate for class c, level 1

ψ^1_c = the dropout rate for class c, level 1

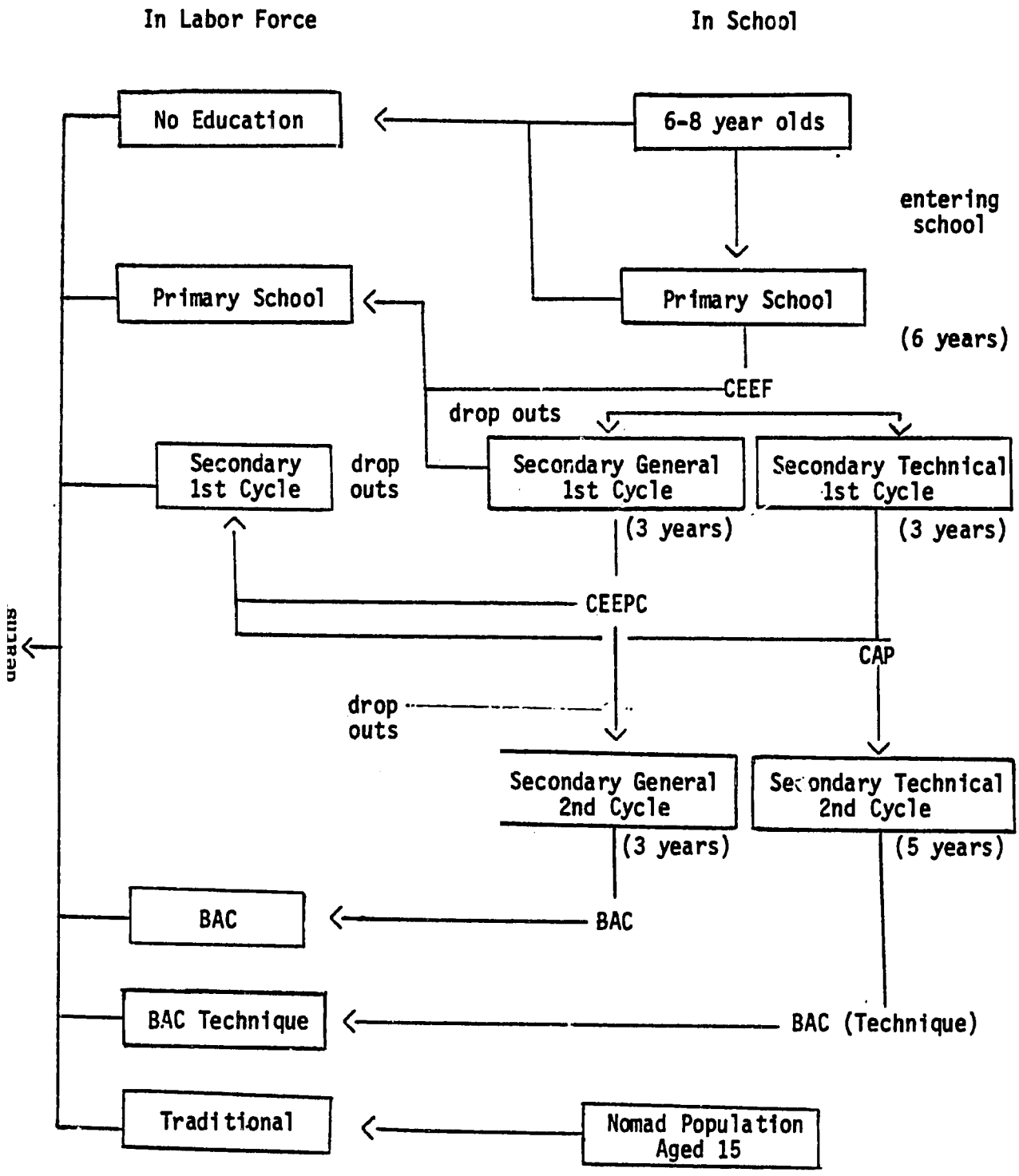
SR_c = the survival rate for students at the age corresponding to the average age in class c.

Note that in this system the age of students at any given class level is not known. While it is technically possible to keep track of students by class and age, lack of an age distribution of the initial student population for Mauritania prevented us from doing this. However, enrollment is influenced by the age distribution particularly in primary school where entry in the first class is a function of the number of children between 6 and 8 years old.

A diagram of the system as contained in the education submodel is shown in Table 2. After six years in primary school, the successful student obtains his CEEF degree and may go on to either secondary general or technical school for the first cycle. Note that no women are assumed to be enrolled in the technical stream. After completing the first cycle, he obtains either the

Table 2.

Education System and Labor Force by Skill



CEEPC degree in secondary general or the CAP in technical school and goes on to the second cycle or drops out. Some general students switch to the technical stream. There are then three more years in the second cycle of the general school and five in the technical school. Graduation from secondary general gives the BAC while graduation from secondary technical gives the BAC technique.

First year entry into any given level (a level corresponding to a box in Table 2) is determined by an enrollment rate times the eligible population. This occurs principally at the entry into primary and secondary school (first level). Entry into the second cycle of secondary school occurs as if students continued to the next level (after allowing for repeats and drops), except that some general students switch over to a technical stream after the first level. In all of these cases a growth rate is applied each period to allow for increased interest in education.

As mentioned above, we were unable to apply a similar model to traditional education. Yet traditional education continues to play an important role in Mauritania and 12 percent of the sedentary workforce in 1977[1] had a traditional education. Hence, we cannot ignore this phenomena. In the absence of any quantitative data we calculated the students in the traditional sector as being the same as the nomad population between ages seven and twelve. No classes, dropouts or repeats, are kept track of. "Graduates" are taken to be the same each year as the nomad population which reaches age thirteen. This is then added to the surviving stock of manpower with a traditional education to maintain current levels of traditionally educated manpower.

[1] RAMS FS3-1, Table 2.5

Labor Force

In addition to calculating the student population, the education submodel generates the manpower stock by six education levels: no education, primary school, traditional education, first cycle--secondary (technique and general), BAC general, and BAC technique. Starting with an initial educational profile of the working population, this is updated each period as students drop out and enter the workforce or are graduated and enter the workforce. Someone who enters the workforce is assumed to be in the skill category corresponding to the highest level reached in the system, except that if he drops out before finishing a stream he is given no credit for years completed. Thus, a student who completed five years of primary school and who drops out to enter the workforce is classified as not having any education. A flow chart which summarizes the determination of the labor force is given in Figure 2. In general, the labor force at any given education level ($ES_{j,t}$) in any given year is determined by the previous period's labor force minus deaths plus those attaining the given education level in the current year ($GRADS_{j,t}$) but not going to a higher level plus drop-outs from the next highest level ($DROPS_{j+1,t}$):

$$ES_{jt} = ES_{j,t-1}\,(\bar{S}_t) + \sum_{s=1}^{2} (GRADS_{s,j,t} + DROPS_{s,j+1,t} - E_{1,t}^{j+1})\,(LFPR_S)$$

where

$$GRADS_{s,j,t} = \sum_{s=1}^{2} E_{s,\bar{c},t}^{j}(1 - r_{\bar{c}}^{j} - \psi_{\bar{c}}^{j})$$

and

$\bar{c}$ = the highest class at level j

$\bar{S}_t$ = the average survival probability for the population ages 10-59,

$LFPR_S$ = the labor force participation rate of sex S.

$$DROPS_{s,j+1,t} = \sum_{s=1}^{2} \sum_{c=1}^{\bar{\bar{c}}} E^{j+1}_{s,c,t} \, r^{j+1}_{c}$$

and

$\bar{\bar{c}}$ = the highest class at level j+1,

The labor force for the traditional sector is somewhat simpler. Traditional education in the present version of this model is crudely assumed to apply only to the nomad population. The stock of traditionally educated manpower is augmented each period by the proportion of the nomad population aged 15 which migrates to the two sedentary sectors. This is also adjusted for labor force participation rates.

The labor force, it will be noted, is influenced by three main variables: the size of the population, school attendence, and labor force participation. Population size is in turn affected by mortality and fertility, while school attendance is influenced by repetition and dropout rates (r^j_c, ψ^j_c) as explained later on.

There are only two labor force participation rates used in the present model (one for each sex) and these do not change over time. In the earlier version of the model, female labor force participation is influenced by fertility and other variables but lack of an adequate data base precluded use of an endogenous rate in the present model. Also age-specific rates could not be used due to the absence of data for the age structure of the labor force by skill level.

Educational Resource Needs

Educational resource needs are calculated by applying fixed coefficients to the student population at each level. Hence, the number of required teachers is obtained by use of a fixed student/teacher ratio and the number of

classrooms by applying a fixed student/class ratio. Hence

$$PROF_l = \sum_c E_c^l/\alpha_l$$

$$CLASS_l = \sum_c E_c^l/\beta_l$$

where

$PROF_l$ = the required number of teachers at level l

$CLASS_l$ = the required number of classrooms at level l

α_l = the teacher/student ratio for level l

β_l = the classroom/student ratio for level l

E_c^l = the enrollment in class c, level l.

Employment

Recall that available manpower in the model is derived from the education submodel where the stock of qualified manpower by 6 education levels in each period is generated: no education, traditional education, primary school, first cycle secondary general school, second cycle secondary school, and secondary technical school. In the manpower and employment submodel, both levels of secondary general are aggregated together so that there are five levels of manpower by skill level in the employment submodel. This was necessary because the RAMS data used to parameterize and initialize the model had only five categories.

Employment is then calculated by ten economic sectors and by the five skill levels. Again the choice of economic sectors was determined by that found in RAMS and the 1977 census. The ten economic sectors are:

1. Agriculture
2. Mining, water and electricity
3. Modern industry
4. Traditional industry
5. Construction
6. Commerce
7. Transport and communication
8. Government and finance
9. Services
10. Other

The employment submodel was not designed to predict actual levels of employment by skill level and economic sector. To have done so would have required more data than were available to us as well as the necessity to make assumptions about the way the labor market works in Mauritania. Instead, the submodel is designed to aid in the planning process by indicating where bottlenecks and surpluses may occur given the evolution of the education system and the economy. This is achieved by calculating employment "needs" by sector and skill level and comparing the total requirement for employment by skill level with available manpower in the same categories.

Employment needs by sector are calculated by using labor productivity coefficients in conjunction with the value-added in that sector. Thus,

$$D_i = \theta_i \cdot XX_i \qquad i = 1, \ldots 10$$

where

D_i = employment needs in sector i

θ_i = the inverse of labor productivity in sector i

XX_i = value-added in sector i.

Value added is exogenous in the model. The sectors from the economic model used in determining XX_i are discussed later on. Given the total manpower requirements in industry i, D_i, the requirements per skill level are derived from a technology matrix B, where b_{ij} is an element of that matrix and represents the proportion of the workforce in industry i required at skill level j. Thus,

$$ED_{ij} = b_{ij}D_i \qquad \begin{array}{l} i = 1, \ldots, 10 \\ j = 1, \ldots, 5 \end{array}$$

where

ED_{ij} = required workers in industry i with skill level j.

On the supply side, as indicated above, the supply of manpower by skill level j, ES_j is derived from the education submodel. Bottlenecks and shortages can then be anticipated at the level of skills where one can compare the available manpower at skill level j, ES_j with the employment requirements at that level, $\overset{10}{\quad} ED_{ij}$. It is to be noted that the elements of the matrix B do not change during a simulation in this model. In a market environment this is not likely to be the case. When a shortage of a particular skill type develops ($ES_j \underset{i=1}{\overset{10}{\quad}} ED_{ij}$), we might expect wages to rise for skilled workers in short supply so that b_{ij} would diminish as firms substitute away from the more expensive workers. Conversely if $ES_j \underset{j=1}{\quad} ED_{ij}$ we would expect wages to rise for workers in that industry so that b_{ij} would rise. Since the elements of the B matrix do not change, to the extent that a market system operates in Mauritania, the model overestimates shortages or surpluses. While it would have been preferable to have the B matrix adjust, lack of information prevented us from incorporating that feature in the model at this time.

Value - Added

The employment and manpower variables are calculated using inputs from the education model. Initial value - added is derived from the P.A.C.N.M. II model for Mauritania. Growth rates are then specified and value added for each period for the ten sectors of the model are calculated. The correspondence of the value-added from the P.A.C.N.M. II model with the economic sectors specified in the current submodel is as follows:

Manpower and employment submodel

P.A.C.N.M. II

(i)	(XX_i)
1. Agriculture	VAR + VAE + VAP
2. Mining, water, electricity	VAM
3. Modern industry	VAIMMC + VANINMI
4. Traditional industry	VAST
5. Construction	VASMCO
6. Commerce	VASMNC
7. Transport and Communications	VASMNC
8. Government and finance	VAD + VASMNC
9. Services	VASMNC
10. Other	PIBCF

A one-to-one correspondence does not exist as sector definitions in the employment and economic models did not sufficiently overlap. Hence in some cases the XX_i cannot be interpreted as output levels corresponding to the employment sectors but rather as economic sectors whose output influences employment in sector i.

Initialization and Parameters

The education submodel is initialized with data and runs with parameters drawn from RAMS FS3-2, "Evaluation of the Formal Education System in Relation to Development Objectives." The principle parameters are presented below, followed by initial values of the student population.

Repeat and dropout rates (r and ψ respectively) vary by class and level but not by sex and not over time. The rates assumed (in percent) are given below in Table 3.

The entry from primary into secondary school involves a parameter for the proportion of primary school graduates continuing to secondary general and to college technique. For both sexes, the current model uses a figure of 35 percent, a number cited on page 89, RAMS FS3-2. For the percentage of males continuing to lycée technique, we used a figure of 6 percent. This figure was arrived at by applying a graduation rate to the 1977-78 elementary

TABLE 3. REPEAT AND DROPOUT RATES (PERCENT)

	Primary school[1]		Secondary school[2]		Secondary technical[3]	
c	r^1	ψ^1	r^2	ψ^2	r^3	ψ^3
1	1.3	0	7.63	8.26	0	14.0
2	12.4	0	6.13	4.98	10.5	16.0
3	14.9	2.0	7.03	6.82	5.2	6.2
4	19.2	3.8	4.34	3.19	0	13.3
5	14.5	10.1	2.53	2.11	3.5	29.0
6	13.8	6.8	6.53	43.47	7.8	14.0
7	-	-	-	-	11.8	5.9
8	-	-	-	-	9.7	37.2

[1]Source: RAMS FS3-2, Table 9.
[2]Source: RAMS FS3-2, Table 25.
[3]Source: RAMS FS3-2, Tables 41, 42.

school population in the last year of school (4,008 males), and multiplying by 0.641, the probability of graduating. Then the initial enrollment in college technique (1st cycle, secondary technical) is divided by the graduating elementary male pupils:[1]

$$\frac{151}{4{,}008 \times .641} = .058 \approx 6\%$$

The transition from first cycle of secondary general to second cycle of technical (lycée technique) is arrived at in a similar fashion. According to RAMS, 34.7 percent of first year lycée technique students were transfers.[2] Since there were 78 students enrolled in the first year, 27 students ($0.347 \times 78 = 27$) must have transferred. With a pass-on rate of 86 percent, 1,441 graduating third year general students ($0.86 \times 1{,}676 = 1{,}441$) were eligible to transfer. The resulting transfer rate is calculated as 2 percent: $27/1{,}441 = 0.02$.

[1]Sources of initial enrollments are discussed subsequently.
[2]RAMS FS3-2, p. 116.

Enrollment for the first year in primary school in Mauritania takes place between ages six and eight. Since we had no information on the age structure of the student population, we calculated three entry rates (e_i) for each of the ages, six, seven, and eight from initial enrollment figures and the initial age structure of the population. Initial enrollment for sex s, $E^1_{1,s,o}$, is proportionally distributed over the three cohorts after taking account of the possibility of repeating a course, and the resulting figure is then divided by the population in the cohort. Notice that there is no disaggregation between urban and rural sedentary populations, although there is by sex:

age 6
$$e_{S,1} = \frac{E^1_{1,S,0}\left(\sum_{L=1}^{2} P^0_{S,L,6} \div \sum_{K=6}^{8}\sum_{L=1}^{2} P^0_{S,6,K}\right)}{\sum_{L=1}^{2} P_{S,L,6}} \; ; \; S=1,2$$

ages 7, 8
$$e_{S,i} = \frac{E^1_{1,S;0} \cdot (1-\psi^1_1)\left(\sum_{L=1}^{2} P^0_{S,L,i} \div \sum_{K=6}^{8}\sum_{L=1}^{2} P_{S,L,K}\right)}{\sum_{L=1}^{2} P_{S,L,i}} \; ; \; \begin{array}{l} S = 1,2 \\ i = 7,8 \end{array}$$

The initial labor force by education level is calculated by first estimating the sedentary labor force and then multiplying this by initial fractions of the labor force in each skill category. The overall sedentary labor force is calculated by applying labor force participation rates to the rural sedentary and urban populations. Male participation rates were taken from ILO estimates for 1975 while the single female labor force participation rate, also used in subsequent periods, is a weighted average of adult age-specific rates. These rates are given in Table 4. The initial fractions of the labor force at each education level are shown in Table 5. These are derived from RAMS, FS3-1, Table 2.5.

Table 4.
Labor Force Participation Rates, 1975

Age	Male	Female
0 - 9	0	0
10 - 14	45.22	3.48
15 - 19	87.91	3.89
20 - 24	96.56	2.89
25 - 44	98.50	3.83
45 - 54	97.90	5.32
55 - 64	94.35	4.96
65+	77.87	2.29

Source: I.L.O., Labor Force Projections: 1965-1985.

Table 5.
Proportion of Initial Labor Force by Eduation Level

No education	.78
Primary	.06
First cycle secondary	.02
Second cycle secondary	.01
Technical and professional	.01
Traditional	.12
	1.00

Source: RAMS, FS3-1, Table 2.5.

There are only two explicitly used labor force participation rates in the model: male and female. This was due in part, to a lack of age structure data for the labor force. While it may seem extremely simplistic, in fact it is probably not that far from reality given the structure of the model. Firstly, adult male labor force participation rates are usually constant and between 98-100 percent. Female rates are more variable, particularly in the fertile age groups, but in Mauritania the variation does not seem very great. Secondly, for the early age groups, i.e., under 20, the implicit economic activity rates are lower than these two rates due to school attendance.

The parameters for educational resource needs were taken from RAMS sources. In some cases, figures were not available so that we had to supply hypothetical figures. In any case these ratios are more properly viewed a "policy variables" than fixed parameters outside of government control. The values used in the current version of the model are listed below in Table 6.

Table 6.
Educational Resource Ratios

	Student/teacher ratio (α_1)	Student/classroom ratio (β_1)
Primary school	45	55
Secondary school	27	30
College technique	11	25*
Lycee technique	6	25*

*Hypothetical.

Initial enrollment figures for primary, secondary general, and secondary technical school are listed below in Table 7. Once again we relied on RAMS sources.

TABLE 7. INITIAL ENROLLMENT, 1977

	Primary school[1]		Secondary school[2]		Secondary technical[3]
c	Female	Male	Female	Male	Male
1	5,288	10,129	847	3,072	141
2	5,302	10,155	610	2,216	133
3	4,582	8,778	461	1,676	96
4	3,097	5,933	326	1,368	24
5	2,256	4,321	297	1,079	74
6	2,405	4,607	103	374	70
7	-	-	-	-	46
8	-	-	-	-	4[illegible]

[1]Source: RAMS FS3-2, Appendix 10; 14.
[2]Source: RAMS FS3-2, p. 88; Table 25, p. 92.
[3]Average 1977-1979, Source: RAMS FS3-2, Appendix 32.

The inverse labor productivity coefficient Θ_i is determined as part of the model's initialization. Given an assumed value for U_j, unemployment by skill, initial value of ES_j, and the matrix A, ED^0_{ij} is determined.

$$ED^0_{ij} = A_{ij}\ ES^0_j\ (1-U_j)$$

where

ED^0_{ij} = initial employment in sector i, skill level j

ES^0_j = initial labor force with skill level j

U_j = initial unemployment rate for workers with skill level j

A_{ij} = proportion of labor force with skill j employed in industry i (an element of A)

Then, initial labor requirements D_i can be determined:

$$D^0_i \equiv \sum_{j=1}^{5} ED^0_{ij}$$

and given the initial levels of XX_i, $_i$ is defined by

$$\Theta_i \equiv \frac{D^0_i}{XX^0_i}$$

where XX^0_i is the first period value of XX_i.

The unemployment rates by skill level are based on data contained in RAMS report FS3-1, Table 1.5 which in turn are derived from the 1977 census. Calculation of the U_i is given in Table 8 below.

The A matrix is also taken from RAMS FS3-1, this time table 2.7. The elements of A are taken from the rows entitled "% by education." Matrix A is shown in Table 9. The B matrix is taken from the same source as A except the elements are the rows entitled "% by sector".

TABLE 8. SEDENTARY UNEMPLOYMENT BY EDUCATION LEVEL, 1977

	Unemployed	Labor force*	% Unemployed (U_i)
No education	30,480	230,680	13.2
Traditional education			
Family	5,380	29,910	
Organized	1,250	8,290	
Total	6,630	38,200	17.4
Primary education	4,150	20,190	20.5
Secondary and higher	1,150	9,040	12.7
Technical and professional	40	2,830	1.4
		300,940	

*Labor force = unemployed + salaried workers + dependent workers + self-employed + owners + family workers.

Source: RAMS, FS3-1, Table 1.5.

4. Nutrition and Health

Structure

The nutrition and health subsystem of the human resources model provides information on the food and health personnel requirements in accord with WHO international standards. At this point the model does not predict what actual or expected levels of nutrition and food consumption are for Mauritania. That stage in model development would require knowing production and consumption in Mauritania by type of food stuff. However, since livestock is projected in the model, livestock by-products (meat and milk) can be compared to food needs. Nevertheless, the nutrition submodel should provide valuable information to the planner on the food requirements of the population. In fact, according to the joint FAO/WHO committee:

TABLE 9. PERCENTAGE DISTRIBUTION OF EMPLOYED LABOR FORCE BY EDUCATION AND BY INDUSTRY (A)

	Agriculture	Extraction, water, elect.	Modern mfg.	Craft mfg.	Const. and public wks.	Commerce, rest., hotels	Transport communi-cations	Govt. and finance	Houshold and bus. services	Other
No education	55.6	1.6	0.4	4.6	3.6	7.3	1.4	5.4	8.4	11.7
Traditional	34.0	1.5	0.4	5.2	2.3	26.6	1.2	7.5	6.0	15.3
Primary	8.8	9.0	0.9	3.4	5.6	7.5	5.1	36.7	5.7	17.3
Secondary	0.9	15.5	1.5	1.4	3.0	6.2	4.5	55.4	2.2	9.4
Technical, professional	0.0	8.5	0.4	0.0	5.6	2.5	1.8	79.4	0.8	1.0

"reasonably valid estimates of national energy needs can be derived since there is reason to believe that if the total supply of food is adequate and social factors are not limiting, individuals will tend to consume energy in proportion to their needs. However, caution must be expressed, since if the total food supply is even slightly low, then socal and other factors may produce a very inequitable distribution within some segments of the population."[1]

Food requirements are calculated in two stages. Firstly, the energy (calorie) requirements of the urban, rural sedentary, and nomad populations are calculated. Secondly, these are translated into food requirements by assuming a standard diet.

Energy needs are calculated using FAO/WHO formulae. RAMS used a variant of these formulae, but it was unclear from their report (RAMS, OP8) how their calculations were made. Daily calorie requirements can be computed for a population if one knows the age distribution of the population, the average weight of the population and how active that population is. The FAO/WHO formulae are reproduced in Table 10. Note that for children nine years and younger an absolute requirement is set. The rather high (1,090 Kcal) requirement for infants is the result of allowing for the extra requirements of pregnant and nursing women. The assumption behind this are given in the joint FAO/WHO report.

Given the method outlined in Table 10, total daily energy requirements, $RCAL_T$, can be calculated as

$$RCAL_T = \sum_{s=1}^{2} \sum_{L=1}^{3} \sum_{K=1}^{65+} RCAL_{S,L,K} \cdot P_{S,L,K}$$

[1]WHO Technical Report Series Number 522, 1973, Report of a joint FAO/WHO committee on energy and protein requirements, page 78.

where $RCAL_{S,L,K}$ = the calorie requirements for sex S, location L, age K, and per capita requirements are then,

$$RCAL_T/POP_T$$

Energy needs are translated into food needs by means of a standard diet or "rations" in combination with the energy content of food stuffs in the diet. The standard diet or ration for population group L is specified in terms of the recommended percentage of calories, $C_{i,L}$, derived from the ith individual foodstuff. The calorie content of the ith foodstuff, g_i, is given in terms of average calories per gram. Hence, total daily food requirements for food type i in region L ($F_{i,L}$) are calculated as:

$$F_{i,L} = \left(\sum_{s=1}^{2} \sum_{k=0}^{65+} RCAL_{S,L,K} \cdot P_{S,L,K} \right) \frac{C_{i,L}}{g_i} \qquad \begin{array}{l} L = 1,3 \\ i = 1, \ldots, 20 \end{array}$$

Of interest would be a comparison of food requirements with food production and/or availability. This would require a more detailed disaggregation of agricultural production and of imports than currently exists in the economic model.

In addition to calculating nutrition and food requirements this submodel also calculates recommended levels of health personnel. These are calculated according to fixed coefficients. Hence, the number of recommended personnel of type n, PN_n, is calculated by

$$PN_n = (\lambda_n)\ POP$$

where

λ_n = the recommended ratio of health personnel type n to the total population.

Table 10.

ENERGY AND PROTEIN REQUIREMENTS

TABLE 26. CALCULATION OF *PER CAPUT* ENERGY REQUIREMENTS

Age group (years)	Requirements according to weight and age (kcal)	(MJ)	Requirements adjusted according to activity (kcal)	(MJ)	Population distribution (%)	Total energy
1	1090	(4.5)	1090	(4.5)		
1–3	1360	(5.7)	1360	(5.7)		
4–6	1830	(7.6)	1830	(7.6)		
7–9	2190	(9.2)	2190	(9.2)		
Male: adolescent, adult						
10–12	2600	(10.9)	2600	(10.9)		
13–15	0.97 *M*		0.97			
16–19	1.02 *M*		1.02			
20–39	1.00 *M*		1.00			
40–49	0.95 *M*		0.95	$\times \frac{M[(100-p)+pA]}{100}$		
50–59	0.90 *M*		0.90			
60–69	0.80 *M*		0.80			
70 +	0.70 *M*		0.70			
Female: adolescent, adult						
10–12	2300	(9.6)	2300	(9.6)		
13–15	1.13 *F*		1.13			
16–19	1.05 *F*		1.05			
20–39	1.00 *F*		1.00			
40–49	0.95 *F*		0.95	$\frac{F[(100-p)+pA]}{100}$		
50–59	0.90 *F*		0.90			
60–69	0.80 *F*		0.80			
70 +	0.70 *F*		0.70			
					Total	
					Per caput	

M = body weight × 46 kcal (0.19 MJ) = requirement of moderately active adult male of given weight.
F = body weight × 40 kcal (0.17 MJ) = requirement of moderately active adult female of given weight.
A = index of adjustment for activities other than moderate: light 0.90, very active 1.17 (exceptional active case)
p = percentage of population that in a given group is not moderately active

Source: WHO, Technical Report 522, p. 80.

Livestock

The livestock projection submodel is an adaptation of the method used by RAMS.[1] Livestock production is seen as a function of the live birth rate of the female livestock, the off-take rate and rainfall. The model projects for cattle, camels, sheep and goats. A simple livestock population projection is calculated on the basis of the following equations:

$$H_{tj} = (H_{t-1j})\ (RR_t)\ (1 + (F_j)(BR_j)) - OT_{t,j}H_{t,j}$$

$$R_t = r_t(.4) + r_{t-1}(.4) + r_{t-2}(.2)$$

$$RR_t = \min\ (R_t/R_{t-1},\ 1)$$

where $H_{t,j}$ = herd size of livestock type j in period t

F_j = proportion of herd which is female for type j

BR_j = live birth rate per year for females of type j

OT_j = off-take rate for livestock type j

R_t = moving average of rainfall in year t

r_t = rainfall in year t

The off-take rate is exogenous in the present model. As such, meat production, V_j, can be calculated from the off-take of the herds and, with an average weight of a carcass, WT_j, compared with meat requirements in the nutrition submodel:

$$V_{jt} = (OT_{jt} \cdot H_{jt}) \cdot WT_j$$

RAMS, "Livestock Subsector Study", 553, Annex A.

An alternative model is to have the offtake rate derived from the nutrition requirements model. In this case V_{jt} is assumed equal to the various meat requirements and OT_{jt} is then solved to meet those requirements:

$$OT_{jt} = V_{jt}/(H_{jt} \cdot WT_j)$$

where $$V_{jt} = \sum_{L=1}^{3} F_{iL} \qquad j = \text{beef, etc.}$$

This would integrate the livestock, nutrition and demographic models. However, since it assumes that nutrition requirements are automatically met, regardless of the supply situation, it is possible that livestock herds could be depleted with a fast enough growth rate of the human population.

In addition to the off-take rate, rainfall also influences the herd size. A 3-year moving average is calculated each year and then an index is computed. If the index is less than one, then rainfall is below average and some effect on the natural death rate of the herds is assumed. If the index is one or above, no effect is assumed and all mortality is derived from the off-take rate. The method is similar to the RAMS method except that with RAMS, rainfall must show a downward trend for 2 consecutive years in a row to have a negative effect on herd size.

Milk production M_{jt}, is calculated by simply multiplying the average yearly milk production per female, M_j, times the number of females.

$$M_{jt} = M_j \, F_j \, H_{jt}$$

The sum of M_{jt} over the four different kinds of livestock can also be compared with the nutrition model's milk requirements.

Initialization and Parameters

The parameters used in the calculation of required calories have already been seen in Table 10. To arrive at food needs the parameters $C_{i,L}$ and g_i are required. Both were taken once again from RAMS sources.

Calories per gram of food stuff i were calculated from RAMS OP8, Part II, Tables 1-5, by dividing recommended grams per day by calories per day. The figures presented below in Table 12, are the average for these tables. The diet coefficients $C_{i,L}$ are derived from the same RAMS sources.

The average weight of Mauritanian men and women according to age is given below in Table 11.

TABLE 11. AVERAGE WEIGHT (in kg)

	Rural sedentary		Nomad and urban	
Ages	Women	Men	Women	Men
13 - 15	45	44	45	44
16 - 19	51	52	51	52
20+	53	58	53	56

SOURCE: RAMS OP8, Table 1, Annex.

Average activity levels, used for the calculation of daily calorie requirements are listed in Table 13 below. The numbers represent percentages of the population in each category.

Lastly the coefficients for the required health personnel are given in Table 14. Although these figures were taken from RAMS, they in turn used WHO recommendations. Similarly to the education subsystem, these personnel requirements can be viewed as policy variables rather than fixed coefficients outside of government control.

TABLE 12. CALORIES PER GRAM AND RECOMMENDED DISTRIBUTION OF CALORIES BY FOOD STUFF

	Calories per gram[1] (g_i)	Percent distribution of calories ($C_{i,L}$)		
		Rural[2]	Urban[3]	Nomad[4]
Rice	3.70	30.5	40.1	30.0
Millet	3.45	18.3	8.6	16.7
Wheat	3.37	12.2	8.6	20.0
Bread, noodles, wheat flour	3.64	3.0	5.8	3.3
Beans, peas	3.40	2.1	1.6	0.8
Unshelled peanuts	4.27	3.0	4.9	0.0
Root vegetables	0.40	0.5	0.5	0.0
Vegetables	0.40	0.8	1.0	0.0
Fruit	0.48	0.5	0.6	0.0
Sugar	4.0	6.3	7.3	6.9
Fish	0.67	1.1	1.9	0.0
Beef	1.28	0.7	2.1	0.2
Sheep	2.0	0.8	1.9	4.3
Chicken	1.53	0.4	0.3	0.0
Camel	0.85	0.7	0.0	0.2
Oil	9.0	5.6	10.7	2.0
Butter	9.0	5.2	2.1	6.1
Milk	0.79	4.1	1.9	8.2
Watermelon seeds	5.18	4.3	0.0	0.0
Dates	6.37	0.0	0.0	1.3
		100.0	100.0	100.0

[1]Source: RAMS (see text).

[2]Source: RAMS OP8, annex Table 1, (Region No. 1).

[3]Source: RAMS OP8, annex Table 5.

[4]Source: RAMS OP8, annex Table 4.

TABLE 13. ACTIVITY LEVELS OF ADULTS BY SEX AND LOCATION (%)

	Light	Moderate	Very active	Extremely active
Rural female	0	75	25	0
Rural male	0	100	0	0
Urban female	50	50	0	0
Urban male	50	50	0	0
Nomad female	75	25	0	0
Nomad male	40	60	0	0

Source: RAMS OP8 Table Annex 1, 2

TABLE 14. HEALTH PERSONNEL RECOMMENDED PER CAPITA
(i)

Physicians	1/10,000
Dentists	1/30,000
Government nurses	1/5,000
Government midwives	1/5,000
Pharmacists	1/50,000
Sanitation engineers	1/250,000
Licensed nurses	1/2,000
Dental technicians	1/2,000
Traditional midwives	1/3,000

Source: RAMS OP8, Table 7, p. 37.

Initialization and Parameters of Livestock

Initial values for herds and the parameters of the model are all taken from RAMS. SS-3 values of those are given in Table 15 below.

TABLE 15. LIVESTOCK PARAMETERS

	F[1]	BR[1]	OT[2]	HO[1]	M[1]	WT[2]
Cattle	.35	.35	.10	1183000	.19	150
Sheep	.45	.35	.30	3688000	.03	16
Camels	.25	.35	.095	721000	.23	180
Goats	.45	.35	.30	353200	.03	16

Sources: [1] RAMS SS-3, Annexe A
[2] R.I.M. IV e Plan, Table 7.27

Appendix A: Sample Output

In this section we present the outputs of the model for two periods - 1980 to 1985. Because of the tentative nature of the model and its parameters at this stage, no attempt will be made to analyze these outputs. They are presented here merely for illustrative purposes.

******MODELE DES RESSOURCES HUMAINES DE LA MAURITANIE*****

******* POPULATION ********
1980

POPULATION SELON GROUPS D'AGES (TOTALE)

	Rurale		Urbaine		Nomade		Totale	
AGE	Femmes	Hommes	Femmes	Hommes	Femmes	Hommes	Femmes	Hommes
<1	16260	17073	10133	10639	9942	10439	36335	38151
1-4	41965	41596	24766	25183	24352	24256	91083	91035
5-9	50813	54753	26060	27977	28750	29776	105623	112506
10-14	43759	49358	21934	24022	24651	26999	90344	100379
15-19	33254	34291	17699	19527	17639	18137	68592	71955
20-24	31818	25502	17971	21671	17750	12597	67539	59770
25-29	24109	17172	13963	19804	14020	9347	52092	46323
30-34	20977	14191	11466	14495	11172	7436	43615	36122
35-39	17261	12313	8556	10472	9696	6498	35513	29283
40-44	15518	12633	7670	9198	9759	7335	32947	29166
45-49	15042	12676	6815	7507	8663	7884	30520	28067
50-54	10515	9326	4608	4826	6917	6888	22040	21040
55-59	10417	8790	4268	3914	5744	5965	20429	18669
60-64	7121	6503	2679	2452	4535	4249	14335	13204
65+	10802	8002	2841	2186	8199	5498	21842	15686

POPULATION SELON GROUPS D'AGES (POURCENTAGE)

	Rurale		Urbaine		Nomade		Totale	
AGE	Femmes	Hommes	Femmes	Hommes	Femmes	Hommes	Femmes	Hommes
<1	4.65	5.27	5.58	5.22	4.93	5.69	4.96	5.36
1-4	12.00	12.83	13.65	12.35	12.07	13.23	12.43	12.80
5-9	14.53	16.89	14.36	13.72	14.25	16.24	14.41	15.82
10-14	12.52	15.23	12.09	11.78	12.22	14.73	12.33	14.11
15-19	9.51	10.58	9.76	9.58	8.74	9.89	9.36	10.11
20-24	9.10	7.87	9.90	10.63	8.80	6.87	9.22	8.40
25-29	6.90	5.30	7.70	9.71	6.95	5.10	7.11	6.51
30-34	6.00	4.38	6.32	7.11	5.54	4.06	5.95	5.08
35-39	4.94	3.80	4.72	5.14	4.80	3.54	4.85	4.12
40-44	4.44	3.90	4.23	4.51	4.84	4.00	4.50	4.10
45-49	4.30	3.91	3.76	3.68	4.29	4.30	4.16	3.95
50-54	3.01	2.88	2.54	2.37	3.43	3.76	3.01	2.96
55-59	2.98	2.71	2.35	1.92	2.85	3.25	2.79	2.62
60-64	2.04	2.01	1.48	1.20	2.25	2.32	1.96	1.86
65+	3.09	2.47	1.57	1.07	4.06	3.00	2.98	2.21

	RURALE	URBAINE	NOMADE	TOTALE
Population Totale	673823	385316	385110	1444249
Pourcentage	46.66	26.68	26.67	100.00
Taux de Fecondite	6.80	8.00	6.80	7.11
Taux Brut de Fecondite	51.63	57.83	50.14	52.89
Taux de Dependence	98.51	87.65	100.32	94.84
Taux de Croissance	4.12	7.56	-4.82	2.65

******MODELE DES RESSOURCES HUMAINES DE LA MAURITANIE*****

**** NOURRITURE REQUISE ****
1980

CALORIES PAR TETE PAR JOUR
RURAL 2085 URBAIN 2027 NOMAD 1998

PRODUITS AGRICOLES REQUISES PAR AN
(par milliers de kgs.)

	RURALS	URBAINS	NOMADS	TOTALES
Riz	42239	30881	22759	95879
Millet	27220	7113	13608	47942
Ble	18585	7285	16690	42560
Pain,Pates,Farine	4232	4549	2550	11331
Haricots,Petits pois	3167	1342	661	5169
Cacahouetes	3601	3270	0	6871
Legumes(Racines)	3334	1854	0	5188
Legumes	10258	7130	0	17389
Fruits	5334	3560	0	8894
Sucre	8078	5205	4847	18131
Poisson	8407	8075	0	16481
Boeuf	2801	4672	438	7911
Mutton	2052	2710	6041	10802
Poulet	1334	556	0	1890
Chameau	4201	0	657	4858
Huile	3188	3388	624	7200
Beurre	2961	665	1903	5528
Lait	26644	6866	29192	62703
Graines de pasteque	4257	0	0	4257
Dattes	0	0	573	573

PRODUITS AGRICOLES REQUISES PAR TETE PAR AN
(en kgs.)

	RURALS	URBAINS	NOMADS	TOTALES
Riz	62	80	59	66
Millet	40	18	35	33
Ble	27	18	43	29
Pain,Pates,Farine	6	11	6	7
Haricots,Petits pois	4	3	1	3
Cacahouetes	5	8	0	4
Legumes(Racines)	4	4	0	3
Legumes	15	18	0	12
Fruits	7	9	0	6
Sucre	11	13	12	12
Poisson	12	20	0	11
Boeuf	4	12	1	5
Mutton	3	7	15	7
Poulet	1	1	0	1
Chameau	6	0	1	3
Huile	4	8	1	4
Beurre	4	1	4	3
Lait	39	17	75	43
Graines de pasteque	6	0	0	2
Dattes	0	0	1	0

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**** PERSONNELS REQUISES: SANTE PUBLIQUE ***

	1980
Medicins	144
Dentistes	48
Infirmieres(Gouv)	288
Sage-femmes	288
Pharmaciens	28
Inspecteurs Sanitaires	5
Infirmieres(Privees)	722
Techniciens Dentales	722
Sage-femmes(Trad.)	481

*****ELEVAGE*****

Pluviometrie 241
Indice 1.0186

	Taille Initiale des Troupeaux	Accroissement	Abattage	Taille finale des Troupeaux	Lait	Viande
		(par milliers)				
Bovins	1263	155	126	1292	85	18952
Ovins	2323	366	697	1992	29	11149
Camelins	715	63	64	713	41	11582
Caprins	2224	350	667	1907	28	10677

**** MAIN D'OEUVRE ****
1980

Taux d'Activite Masculin 87.96
Taux d'Activite Feminin 4.30

MAIN D'OEUVRE SELON NIVEAU D'ENSEINGEMENT

	NOMBRE	(%)
Aucune	292712	.76
Traditionnelle	44527	.12
Ecole Fondamentale	28184	.07
Secondaire-Premiere Cycle	9192	.02
Secondiaire-Deuxieme Cycle(BAC)	5366	.01
BAC Technique	3775	.01
Totale	383756	100.00

******MODELE DES RESSOURCES HUMAINES DE LA MAURITANIE*****

**** ENSEIGNEMENT ****
1980

Ecole Fondamentale

	Eleves		Abandons	
	Filles	Garcons	Filles	Garcons
1	13739	16762	0	0
2	11284	14325	0	0
3	8854	11956	133	198
4	6511	10171	205	393
5	4785	9179	458	878
6	3825	7338	212	407
Totale		118730		
CEEF		9105		

Secondaire Generale

	Eleves		Abandons	
	Filles	Garcons	Filles	Garcons
1	3220	3221	0	0
2	2066	2028	91	91
3	1730	1709	121	141
4	1511	1814	20	69
5	581	2035	10	36
6	476	1702	169	616
Totale		21211		
CEEPC		3205		
BAC		898		

Secondaire Technique

	Eleves		Abandons	
	Filles	Garcons	Filles	Garcons
1	0	513	0	48
2	0	317	0	41
3	0	195	0	12
4	0	205	0	17
5	0	112	0	34
6	0	84	0	11
7	0	65	0	1
8	0	22	0	17
Totale		1515		
CAP		174	BACT	24

ENSEIGNEMENT TRADITIONELLE 70471

Besoins Educationnels

	PROFESSEURS	CLASSES
Ecole Fondamentale	2638	2159
Secondaire Generale	786	707
College Technique	112	49
Lycee Technique	47	11

******* EMPLOI *********
1980

EMPLOI SELON NIVEAU D'EDUCATION ET SECTEUR

	Aucune	Trad.	Fond.	Second. Gen.	Tech. Prof.	Totale
Agriculture	180130	18294	2613	0	0	201038
% Par Secteur	57.58	37.61	11.08	0.00	0.00	
% Par Education	89.60	9.10	1.30	0.00	0.00	
Mine/Eau/Elect	4782	690	2069	1782	326	9648
% Par Secteur	1.53	1.42	8.77	15.64	8.50	
% Par Education	49.56	7.15	21.45	18.47	3.38	
Ind.Mod.	1195	184	207	172	15	1774
% Par Secteur	.38	.38	.88	1.51	.40	
% Par Education	67.39	10.37	11.66	9.72	.86	
Ind.Trad.	13748	2391	782	161	0	17082
% Par Secteur	4.39	4.92	3.31	1.41	0.00	
% Par Education	80.48	14.00	4.58	.94	0.00	
Const.	10759	1058	1287	345	215	13664
% Par Secteur	3.44	2.17	5.46	3.03	5.60	
% Par Education	78.74	7.74	9.42	2.52	1.57	
Commerce	21818	12231	1724	713	96	36581
% Par Secteur	6.97	25.14	7.31	6.26	2.50	
% Par Education	59.64	33.43	4.71	1.95	.26	
Transport	4184	552	1172	517	69	6495
% Par Secteur	1.34	1.13	4.97	4.54	1.80	
% Par Education	64.42	8.50	18.05	7.96	1.06	
Gouvt/Fin.	16139	3449	8437	6368	3042	37435
% Par Secteur	5.16	7.09	35.78	55.90	79.40	
% Par Education	43.11	9.21	22.54	17.01	8.13	
Services	25105	2759	1310	253	31	29458
% Par Secteur	8.03	5.67	5.56	2.22	.80	
% Par Education	85.22	9.37	4.45	.86	.10	
Autre	34968	7035	3977	1081	38	47099
% Par Secteur	11.18	14.46	16.87	9.49	1.00	
% Par Education	74.24	14.94	8.44	2.29	.08	
Totale	312829	48641	23580	11392	3832	400274
% Par Secteur	100.00	100.00	100.00	100.00	100.00	
% Par Education	78.15	12.15	5.89	2.85	.96	

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******MODELE DES RESSOURCES HUMAINES DE LA MAURITANIE*****

******* POPULATION ********
1985

POPULATION SELON GROUPS D'AGES (TOTALE)

	Rurale		Urbaine		Nomade		Totale	
AGE	Femmes	Hommes	Femmes	Hommes	Femmes	Hommes	Femmes	Hommes
<1	19754	20742	14043	14746	7744	8131	41541	43619
1-4	57388	58069	40486	40967	22460	22727	120334	121763
5-9	54333	54065	36667	37085	20582	20550	111582	111700
10-14	52307	56201	31195	33477	19185	19907	102687	109585
15-19	44871	50493	26273	28907	16395	17977	87539	97377
20-24	33577	34582	20702	22546	11634	11954	65913	69082
25-29	32116	25323	20744	23374	11634	8236	64494	56933
30-34	24315	17116	15999	20627	9135	6067	49449	43810
35-39	20807	13935	13112	15098	7236	4777	41155	33810
40-44	17127	11936	9940	10979	6240	4116	33307	27031
45-49	15453	12144	8902	9699	6218	4557	30573	26400
50-54	14545	11987	7847	8005	5413	4771	27805	24763
55-59	9978	8666	5218	5136	4180	4003	19376	17805
60-64	9188	7607	4589	4025	3287	3264	17064	14896
65+	7897	6141	2689	2177	5084	3696	15670	12014

POPULATION SELON GROUPS D'AGES (POURCENTAGE)

	Rurale		Urbaine		Nomade		Totale	
AGE	Femmes	Hommes	Femmes	Hommes	Femmes	Hommes	Femmes	Hommes
<1	4.78	5.33	5.43	5.33	4.95	5.62	5.01	5.38
1-4	13.87	14.93	15.67	14.80	14.36	15.70	14.52	15.02
5-9	13.13	13.90	14.19	13.40	13.16	14.20	13.47	13.78
10-14	12.64	14.45	12.07	12.09	12.26	13.75	12.39	13.52
15-19	10.85	12.98	10.17	10.44	10.48	12.42	10.57	12.01
20-24	8.12	8.89	8.01	8.14	7.44	8.26	7.96	8.52
25-29	7.76	6.51	8.03	8.44	7.44	5.69	7.78	7.02
30-34	5.88	4.40	6.19	7.45	5.84	4.19	5.97	5.40
35-39	5.03	3.58	5.07	5.45	4.63	3.30	4.97	4.17
40-44	4.14	3.07	3.85	3.97	3.99	2.84	4.02	3.33
45-49	3.74	3.12	3.44	3.50	3.97	3.15	3.69	3.26
50-54	3.52	3.08	3.04	2.89	3.46	3.30	3.36	3.05
55-59	2.41	2.23	2.02	1.86	2.67	2.77	2.34	2.20
60-64	2.22	1.96	1.78	1.45	2.10	2.26	2.06	1.84
65+	1.91	1.58	1.04	.79	3.25	2.55	1.89	1.48

	RURALE	URBAINE	NOMADE	TOTALE
Population Totale	802681	535268	301175	1639124
Pourcentage	48.97	32.66	18.37	100.00
Taux de Fecondite	6.80	8.00	6.80	7.17
Taux Brut de Fecondite	52.29	57.16	50.37	53.53
Taux de Dependence	93.05	91.84	99.31	93.15
Taux de Croissance	3.25	6.37	-4.76	2.80

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******MODELE DES RESSOURCES HUMAINES DE LA MAURITANIE*****

**** NOURRITURE REQUISE ****
1985

CALORIES PAR TETE PAR JOUR
RURAL 2075 URBAIN 2000 NOMAD 1982

PRODUITS AGRICOLES REQUISES PAR AN
(par milliers de kgs.)

	RURALS	URBAINS	NOMADS	TOTALES
Riz	50069	42310	17652	110031
Millet	32266	9746	10554	52567
Ble	22030	9981	12944	44956
Pain,Pates,Farine	5016	6233	1978	13227
Haricots,Petits pois	3754	1838	513	6105
Cacahouetes	4268	4481	0	8749
Legumes(Racines)	3952	2540	0	6492
Legumes	12160	9770	0	21930
Fruits	6323	4877	0	11200
Sucre	9576	7132	3759	20467
Poisson	9965	11063	0	21028
Boeuf	3320	6401	340	10061
Mutton	2432	3712	4685	10830
Poulet	1581	762	0	2343
Chameau	4980	0	510	5489
Huile	3779	4641	484	8904
Beurre	3509	911	1476	5896
Lait	31584	9407	22641	63632
Graines de pasteque	5046	0	0	5046
Dattes	0	0	445	445

PRODUITS AGRICOLES REQUISES PAR TETE PAR AN
(en kgs.)

	RURALS	URBAINS	NOMADS	TOTALES
Riz	62	79	58	67
Millet	40	18	35	32
Ble	27	18	42	27
Pain,Pates,Farine	6	11	6	8
Haricots,Petits pois	4	3	1	3
Cacahouetes	5	8	0	5
Legumes(Racines)	4	4	0	3
Legumes	15	18	0	13
Fruits	7	9	0	6
Sucre	11	13	12	12
Poisson	12	20	0	12
Boeuf	4	11	1	6
Mutton	3	6	15	6
Poulet	1	1	0	1
Chameau	6	0	1	3
Huile	4	8	1	5
Beurre	4	1	4	3
Lait	39	17	75	38
Graines de pasteque	6	0	0	3
Dattes	0	0	1	0

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**** PERSONNELS REQUISES: SANTE PUBLIQUE ****

	1985
Medicins	163
Dentistes	54
Infirmieres(Gouv)	327
Sage-femmes	327
Pharmaciens	32
Inspecteurs Sanitaires	6
Infirmieres(Privees)	819
Techniciens Dentales	819
Sage-femmes(Trad.)	546

*****ELEVAGE*****

Pluviometrie 250
Indice 1.0000

	Taille Initiale des Troupeaux	Accroissement (par milliers)	Abattage	Taille finale des Troupeaux	Lait	Viande
Bovins	1388	170	139	1419	93	20816
Ovins	1054	166	316	904	13	[illegible]
Camelins	694	61	62	692	[illegible]	11242
Caprins	1009	159	303	866	13	4845

**** MAIN D'OEUVRE ****
1985

Taux d'Activite Masculin 88.30
Taux d'Activite Feminin 4.30

MAIN D'OEUVRE SELON NIVEAU D'ENSEINGEMENT

	NOMBRE	(%)
Aucune	287220	.72
Traditionnelle	42311	.11
Ecole Fondamentale	42587	.11
Secondaire-Premiere Cycle	13136	.03
Secondiaire-Deuxieme Cycle(BAC)	8888	.02
BAC Technique	3726	.01
Totale	397870	100.00

******MODELE DES RESSOURCES HUMAINES DE LA MAURITANIE ****

**** ENSEIGNEMENT ****
1985

Ecole Fondamentale

	Eleves		Abandons	
	Filles	Garcons	Filles	Garcons
1	[illegible]	26206	0	0
2	20481	21[illegible]	0	0
3	16[illegible]	18612	328	378
4	[illegible]	19028	562	676
5	12949	15655	1139	1425
6	9533	12013	535	708
Totale		214430		
CEEF		18278		

Secondaire Generale

	Eleves		Abandons	
	Filles	Garcons	Filles	Garcons
1	7341	7341	0	0
2	5217	5115	218	214
3	4120	3960	264	254
4	3351	3222	95	91
5	2775	2670	46	44
6	2169	2089	713	692
Totale		47951		
CEEFC		6325		
BAC		1606		

Secondaire Technique

	Eleves		Abandons	
	Filles	Garcons	Filles	Garcons
1	0	1339	0	149
2	0	998	0	134
3	0	640	0	36
4	0	612	0	68
5	0	454	0	100
6	0	246	0	25
7	0	154	0	7
8		112	0	35
Totale		[illegible]55		
CAP		537	BACT	50

ENSEIGNEMENT TRADITIONELLE 43831

Besoins Educationnels

	PROFESSEURS	CLASSES
Ecole Fondamentale	4765	3899
Secondaire Generale	1776	1598
College Technique	326	144
Lycee Technique	161	39

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******* EMPLOI *********
1985

EMPLOI SELON NIVEAU D'EDUCATION ET SECTEUR

	Aucune	Trad.	Fond.	Second. Gen.	Tech. Prof.	Totale
Agriculture	208820	21208	3030	0	0	233058
% Par Secteur	61.14	41.14	12.63	0.00	0.00	
% Par Education	89.60	9.10	1.30	0.00	0.00	
Mine/Eau/Elect	4782	690	2069	1782	326	9648
% Par Secteur	1.40	1.34	8.62	15.64	8.50	
% Par Education	49.56	7.15	21.45	18.47	3.38	
Ind.Mod.	1195	184	207	172	15	1774
% Par Secteur	.35	.36	.86	1.51	.40	
% Par Education	67.39	10.37	11.66	9.72	.86	
Ind.Trad.	13748	2391	782	161	0	17082
% Par Secteur	4.03	4.64	3.26	1.41	0.00	
% Par Education	80.48	14.00	4.58	.94	0.00	
Const.	10759	1058	1287	345	215	13664
% Par Secteur	3.15	2.05	5.37	3.03	5.60	
% Par Education	78.74	7.74	9.42	2.52	1.57	
Commerce	21818	12231	1724	713	96	36581
% Par Secteur	6.39	23.72	7.19	6.26	2.50	
% Par Education	59.64	33.43	4.71	1.95	.26	
Transport	4184	552	1172	517	69	6495
% Par Secteur	1.23	1.07	4.89	4.54	1.80	
% Par Education	64.42	8.50	18.05	7.96	1.06	
Gouvt/Fin.	16139	3449	8437	6368	3042	37435
% Par Secteur	4.73	6.69	35.16	55.90	79.40	
% Par Education	43.11	9.21	22.54	17.01	8.13	
Services	25105	2759	1310	253	31	29458
% Par Secteur	7.35	5.35	5.46	2.22	.80	
% Par Education	85.22	9.37	4.45	.86	.10	
Autre	34968	7035	3977	1081	38	47099
% Par Secteur	10.24	13.65	16.57	9.49	1.00	
% Par Education	74.24	14.94	8.44	2.29	.08	
Totale	341519	51555	23997	11392	3832	432294
% Par Secteur	100.00	100.00	100.00	100.00	100.00	
% Par Education	79.00	11.93	5.55	2.64	.89	

Appendix B:

USER'S GUIDE TO THE HUMAN RESOURCES PLANNING MODEL FOR MAURITANIA

June, 1983

I. Introduction

The Human Resources Planning Model for Mauritania, Version 2 runs on the Hewlett-Packard 86/87 microcomputer. In order to run the model it is necessary to have two disk drives. The model uses four different programs and several data files, all of which reside on floppy disks (See Figure 1). Two of the four programs are utility programs and are not used frequently. An overview of the program structure is given in Figure 2.

The Program "BEERS" is used to split an age distribution of a population from five year to one year age groups. This is necessary since the model projects in single year intervals.

FIGURE I

Files Used by Model

"Drive 0"

Volume: ".MAUR1"*

Program Files

BEERS
CREER
PART1
PART2
RESULTS

Data Files

RPM - 1977
RPF - 1977
UPM - 1977
UPF - 1977
NPM - 1977
NPF - 1977

"Drive 1"

Volume: ".MAUR2"*

Data Files

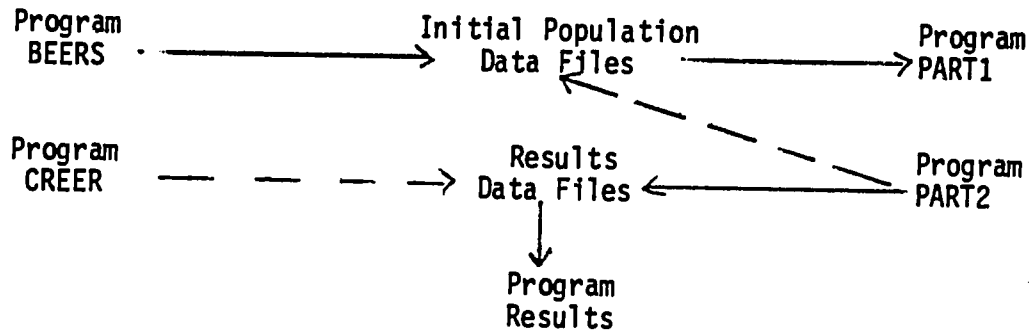
DEMO/RES NN**
EDUC/RES NN
NUT/RES NN

*Name can be changed.

**NN is last two digits of a year, i.e. 77 for 1977.

FIGURE 2

Program Structure



This program creates and stores single year age groups for the male and female populations in each of the three locations identified in the model (rural, urban, nomad). Hence a total of six files (RPM - 1977 etc.) are created in the process of using programs BEERS. Once the initial population age structure files are created there is no further need to use BEERS until new data in five year age groups becomes available which one wants to use.

Program "CREER" sets up disk files on the disk in Drive 1 for the storage of the models' results. There are three files for each period of results corresponding to each of the three main sectors of the model-demography, education and nutrition. If one wanted to run the model for five years a total of fifteen such files would be easily created using CREER.

Program "PART1" is the first part of the two part program which solves the model. PART1 reads and initializes the various parameters and initial values of the model's variables. The program contains data statements which list the values of the various parameters and the user is free to change any of these by simply editing the program using the HP86/87 display editor. This can be saved on disk under a different name so that it is possible to have several versions of PART1 (i.e. PART 1A, PART 1B, etc.) each of which corresponds to a different set of hypotheses and assumptions. PART1 is "chained" to program PART 2 so that when PART1 is "run", PART2 is automatically run.

Program "PART2" contains the equations of the Model itself and performs the calculations for the projections in the various sectors. It is possible to run the model for all three main sectors or only one for however long one likes. In general, the user would only rarely make changes to this program. This might be the case, for example, if it was decided to change the structure of the model by changing an equation. For this type of change, a familiarity with the HP-BASIC programming language is strongly recommended.

Program RESULTS displays the results of the calculations made by PART2. When PART2 is run, it stores its results in the various data files intended for each year and sector (those initially set-up with CREER) on the diskette in Drive1. RESULTS retrieves that information and displays it either on the screen or the printer. The user selects the sector and year of results to be displayed.

Figure 3 outlines a complete list of the steps necessary to run the model if one is starting from the beginning. In practice, one would generally only perform some of the steps listed in Figure 3. The rest of this manual gives a

FIGURE 3

Steps in Using the Programs

1. Set-up initial population files with program BEERS
2. Initialize diskette for results files
3. Create "empty" results files with program CREER
4. Edit data in program PART1
5. Save PART1
6. Run PART1 which automatically runs PART2 which in turn creates results files
7. Run program RESULTS to display or print the contents of the results files.

detailed description of how to perform those tasks which must be performed by the user, in the order in which they will be most frequently used rather than according to the steps shown in Figure 3.

II. How to Run the Model With A Given Set of Assumptions

A basic familiarity with the operation of the HP 86/87 microcomputer is assumed here. In this section we will describe the process by which the model will be run for all three main sectors for three periods and the results displayed. It is assumed that the initial population age distribution and all parameters have been specified for a period of five periods (years).

The first step, after turning on the computer, is to load PART1 into the computer's memory. It is advisable to change the size of the screen display with the command: "PAGESIZE 24". The diskette ".MAUR1" with the program files on it should be in Drive 0 and a diskette with (blank) output files should be in Drive 1. To load PART 1 simply type:

LOAD "PART1"

After the red light on Drive 0 goes out, type or push the button marked:

"RUN"

The screen will clear and the message

Modele des Ressources Humaines de la Mauritanie
Lecture des Donnees

will appear. The power light on the keyboard will blink indicating that the program is executing. You will subsequently be asked questions concerning the sectors and number of periods for which you wish to make a projection.

After a few minutes the message:

Pour combien d'annees voulez-vous faire une projection?
(TAPEZ 1-6)

will appear. Answer this by typing a number which is less than the maximum number indicated in the question. For example, to run the model for five years, simply type:

55

You are then asked if you wish to make a projection for the health/nutrition/livestock sectors:

Voulez-vous faire une projection pour SANTE/NUTRITION/ELEVAGE?
('O'=Oui, 'N'=Non).

Respond with an "O" for yes (oui) or an "N" for no (non). Next you are asked if you wish to make projections for education/labor force/employment:

Voulez-vous faire une projection pour ENSEIGNEMENT/MAIN D'OEUVRE/EMPLOI?
('O' = Oui, 'N' = Non)

Lastly, you will be asked the volume name of the diskette in Drive 1 on which you wish to store the results:

Quel est le nom ('volume') de la disquette
dans 'DRIVE 1'?

After answering the last question the screen will clear and a new message will appear:

Modele des Resources Humaines de la Mauritania
Calculs pour l'an nee 1977

If you responded yes ("O") to both of the questions concerning sectors desired, the computer will then perform projections for health, nutrition, livestock, education, labor force and employment as well as for population. As the projections progress from one period to another, the current year of calculation will be displayed. When the projection is finished, the computer will beep and the message appears:

****** CALCULS TERMINES ******

III. How to Display the Results of a Projection

Once the projections have been made, they are stored on the diskette which was put into Drive 1. To display the results, it is necessary to run the program "RESULTS". Load this program from a diskette in Drive 0 and leave the diskette with the results files in Drive 1 and then push the "RUN" button.

As with the previous program you will be asked a series of questions regarding the sectors and years for which you wish output. When you run the program RESULTS you will see the message:

Modele des Ressources Humaines de la Mauritania
Programmes pour Imprimer les Resultats

Voulez-vous voir les resultats pour le secteur DEMOGRAPHIQUE?
('O' = Oui, 'N' = Non)

After responding to this question, you will be asked if you want to see results for the Nutrition/Health/Livestock sector and subsequently if you want results for education/labor force/employment.

Next you are asked to give the first and last years for which you want results:

Quelle est la premiere annee de resultats que vous voulez?
Quelle est la premiere annee de resultats que vous voulez?
Respond to these questions by specifying the year that you want (i.e. 1985, 1990 etc). If you only want a single year's results give the same year for each question.

Lastly, you will be asked to give the volume of the diskette in Drive 1 from which you wish to read the results. After answering this last question the results will be read from the disk in Drive 1 and displayed on the screen. The display may be temporary halted at any time by pushing the "PAUSE" button. Then, use the "ROLL" key to look at the previous page of results. The display may then be resumed by pushing the "CONT" (continue) button.

Printing the Results

The results may be directed to the printer rather than the screen. To do this, make sure the printer is "ON". Then type:

"PRINTER IS 701"

This will direct all of the output which would ordinarily go to the screen to the printer.

To switch back to the screen type:

"PRINTER IS 1".

IV. Changing the Parameters of the Model

As mentioned previously, the parameters of the Human Resources Planning Model may be easily changed by editing the data in "PART 1". The user should be fully familiar with the "Display Editing" part of Section 1 of the HP86/87 manual.

Table I lists the parameters and variables in the order in which they are found in PART 1. Many of these, for example, the constants in the "Model Life Tables" would never be changed. Others would be changed as new data became available. For example the initial size of livestock herds would only be changed periodically. Still other parameters rates of change, migration rates, etc. - may be changed regularly to analyze the effects of a change in the parameter on the results of the model.

After loading PART1 and listing it, you will see that it consists of program statements which read parameters followed by data statements which contain the data to be read. Figure 4 shows the first set of parameters read in PART2. These parameters must be consistent from the point of view of the number of periods of data they represent. There must always be exactly enough data for the READ statements and the order of the READ and DATA statements must never be changed. Rather that put all of the data together at the end of the program, we have purposely put them next to the READ statements which list the variable names for the data. This should make it easier to identify the data which one wants to change.

The first three parameters are control parameters. They are concerned with the date of the initial period, the maximum number of periods for which the model may be run (LYEAR) and the period in which a population file may be

created for future use (IPP). It is important to understand the significance of the parameters. When the output files are initially created with program CREER, if the STRTYR is 1980, then the first of these must be for 1980 (i.e. DEM/RES80,EDUC/RES80,NUT/RES80). LYEAR gives the maximum number of periods for which it is planned to run the model. Hence if LYEAR is 5, it is planned to run the model for a maximum of 5 periods. This means two things: first, there must be output files on the disk in Drive 1 for 5 periods worth of output. This means 15 files created with CREER. Secondly, there must be 5 periods worth of parameters in PART1. The parameters which are specified for each period are identified with an asterisk in Table I and are also shown in Figure 4. For example, look at the DATA statements in the section marked "Parametres Demographiques". Since LYEAR is set at 5, there are 5 lines of data, each line for a different period. Similarly, we see the same thing in the sections marked "Parametres d'elevage" and "Taux de croissance V.A. par secteur." Note that rainfall per year occurs on a single line and starts at period STRTYR2. That is, if STRTYR is 1980 and LYEAR is 5, then there must be 7 periods of data for rainfall which start in 1978.

Other parameters which occur in PART1 are constant during a projection and and so take on only one value.

V. Running the Model With a New Set of Parameters

Once you have decided on the maximum number of periods for which the model might be run and the values of the parameters have been specified, you are ready to run the model. If you want to keep the changed values of the parameters you must first store the new version of PART1. This can be done in either of two ways. First, you can replace the previous version of "PART1" by issuing the command

"STORE PART1"

Second, you can keep the unaltered version of PART1 under it's original name. For example, you could issue the command

"STORE PART1B"

If you do not store in same fashion the unaltered version of PART1, it will be lost (if "PART1" is the current name of the PART1 program) when you run it. The new parameters will be used to make the projections but they will not be stored. This is because when you run the PART1 program, after it has finished reading the data, it automatically loads the PART2 program in memory at which time PART1 will be lost unless it has been stored on disk.

To run the model, once you have decided about storing PART1, simply push the RUN button, and respond to the questions as previously discussed in Section II above. Notice that while you have specified the maximum number of periods to be, say 5, you may actually run the model for fewer than 5 periods.

VI. Setting Up the Initial Output Files

As previously mentioned, in order for the model to store the results of a projection, results files must have been previously created on the diskette in Drive 1. There must be one file for each of the three main submodels for each year that a projection is desired.

Program CREER will create these files on the diskette in Drive 1. Once they have been created and results stored in them, they may be reused. If it is desired to permanently store results, then a new set of files should be created on another diskette. Before running CREER be certain that the diskette in Drive 1 has been initialized and that it does not already contain results files for years for which you intend to create files. You can verify the diskettes name and contents by doing a catalogue of the diskette with the CAT command:

```
CAT ":D701"
```

You should also know the name (volume) of the disk in Drive 1. If the diskette has no volume name, then one should be assigned using the VOLUME command. For further information on mass storage operations, see Section 20 of the HP-86; 87 manual.

When you run program CREER, you will be asked the first and last years for which you want results files created and the name (volume) of the diskette in Drive 1. The program will then create files for the three main subsectors and will keep you informed as they are created.

If you accidentally try to recreate a file for a year where one already exists, the program will stop and you will receive the message:

ERROR 63 on line 90: DUP NAME

In this case you should verify the contents of the diskette and start over. Similarily, if the volume of the diskette in Drive 1 does not correspond with the one you specified, you will receive the message:

ERROR 125 on line 90: VOLUME

Once again, verify the volume name and start over. Remember that volumes (names) always start with a ".", i.e. ".MAUR2" is a valid volume name.

VII. Setting Up a New Initial Period

The parameters and initial period data on which much of the current version of the Human Resources Model, as developed at RTI, is based are for 1977. This is because the last census was in 1977 and much of the RAMS data are for 1977. As new information becomes available, it will be desirable to initialize the model on a later date. This can be done in two ways which are not necessarily mutually exclusive.

First, if new initial data become availabe from various sources, these can be introduced into the model. Hence if new figures for the population by age, sex and location become available, program BEERS (see below) can be used to establish the necessary population files. In other cases, i.e. school enrolment and livestock herds, the data are entered directly in PART1.

A second approach is to use the model itself to establish initial period values. In other words, if it is desired to start the model in period 1983 rather that 1977, the model can be run until 1983 and then the results for 1983 used to set up initial data files. In this case, parameter IPP in PART1 is set equal to the deserved new initial period and a set of initial population files for that period will be automatically created by the program. Other data, i.e., initial enrolment rates, herd sizes, labor force etc. would have to be read from the results files and PART1 edited to reflect the new starting period.

VIII. Using BEERS to Create Single Year Population Age Group Files

Occasionally, new population data will become available and could be useful for setting up new initial population files. Most likely such data will be in the form of an age distribution for males and females by location by 5 year age groups. As the Human Resources Planning Model projects by a single year method, it is necessary to split the 5 year age groups into single year age groups. This can be done by using the "BEERS" program. In using this program, two sets of files are created: a set of 5 year age group files and a set of single year age group file.

After loading BEERS, push the RUN button and you will be asked:

"Quel nom voulez-vous donner au fichier de 5 ans?"

Respond by giving an appropriate name, for example:

M/5/U/80

for men in the urban region in 1980.

Next, you are asked the number of 5 year groups, including the "open-ended" interval. For example, if the age groups are 0-4, 5-9, ..., 65+, there would be 14 such groups.

Next, you are instructed to put a disk in Drive 0 and press "END LINE". This allows you to store the new files on a different disk than the one currently in Drive 0.

You will then enter the 5 year grouped data for each of the age groups:

```
ENTREZ LES GROUPES DE POPULATION UN PAR UN
Population Age: 0 - 4
?
1000
Population Age 5 - 9
?
850
.
.
.
Population Age 65+:
?
600
```

After entering the last (open-ended) age group, the program will calculate the single year distribution and you will be asked to name the single year file. Here you must be careful because the program for the model expects a certain structure for the names of the single year files. A list of the six files necessary for 1977 is given below. Notice the pattern involved, particularly the year which will correspond with the "STRTYR" parameter in PART 1.

Names for Single Year Population Files

Population Groups		File Name
Rural Males,	1977	RPM - 1977
Rural Females,	1977	RPF - 1977
Urban Males,	1977	UPM - 1977
Urban Females,	1977	UPF - 1977
Nomad Males,	1977	NPM - 1977
Nomad Females,	1977	NPF - 1977

Having specified a name, a message will appear indicating that a new file has been created. For example;

> "13 groupes d'age tires des fichier M/5/U/80 ont ete divises en 66 groupes d'age et stockes dans le fichier UPM - 1980.","

Note that only 13 age groups were split in this example because the 14th age group is the "open-ended' interval and is not split.

Figure 4

```
121 !
122 !
125 ! -----------------PARAMETRES DE CONTROLE-----------------------------
130 READ STRTYR,LYEAR,IPP
140 ! ---------------------------------------------------------------------
150 DATA 1977,10,0
160 ! ---------------------------------------------------------------------
170 FOR K=1 TO LYEAR @ READ EO(1,K),EO(2,K),FR(1,K),FR(2,K),FR(3,K),FLFPR(K)@ NE
XT K
180 ! ----------------- PARAMETRES DEMOGRAPHIQUES---------------------------
190 DATA 39,42.1,6.8,8,6.8,4.3
200 DATA 39,42.1,6.8,8,6.8,4.3
210 DATA 39,42.1,6.8,8,6.8,4.3
220 DATA 39,42.1,6.8,8,6.8,4.3
230 DATA 39,42.1,6.8,8,6.8,4.3
240 DATA 39,42.1,6.8,8,6.8,4.3
241 DATA 39,42.1,6.8,8,6.8,4.3
242 DATA 39,42.1,6.8,8,6.8,4.3
243 DATA 39,42.1,6.8,8,6.8,4.3
244 DATA 39,42.1,6.8,8,6.8,4.3
250 READ RDP,UDP,NDP
260 DATA 8,10,-.5
270 FOR K=1 TO LYEAR @ FOR J=1 TO 4 @ READ ABR(J,K)@ NEXT J @ NEXT K ! BIRTH RAT
E ANIMALS
280 ! --------------------PARAMETRES D'ELEVAGE-------------------------------
290 DATA .35,.35,.35,.35
300 DATA .35,.35,.35,.35
310 DATA .35,.35,.35,.35
320 DATA .35,.35,.35,.35
330 DATA .35,.35,.35,.35
340 DATA .35,.35,.35,.35
341 DATA .35,.35,.35,.35
342 DATA .35,.35,.35,.35
343 DATA .35,.35,.35,.35
344 DATA .35,.35,.35,.35
350 FOR K=1 TO LYEAR+2 @ READ RN(K)@ NEXT K ! RAIN FALL
355 ! ----------------PLUVIOMETRIE PAR AN-----------------------------------
--------------------- (COMMENCEZ A STRTYR-2)---------------
360 DATA 192,230,256,241,250,260,250,250,250,250,250,250
370 REM ------------------V. A. PAR SECTEUR-----------------------------------
380 FOR I=1 TO 10 @ READ VA(I,1)@ NEXT I
390 DATA 7059,4165,2242,54.2,4479,9186,9186,15040,9186,33041
400 REM -------------------TAUX DE CROISSANCE V. A. PAR SECTEUR-----------------
410 FOR K=1 TO LYEAR @ FOR I=1 TO 10 @ READ GVA(I,K)
420 DATA .03,.1,.05,.05,.11,.05,.05,.01,.04,.02
425 DATA .03,.1,.05,.05,.11,.05,.05,.01,.04,.02
430 DATA .03,.1,.05,.05,.11,.05,.05,.01,.04,.02
435 DATA .03,.1,.05,.05,.11,.05,.05,.01,.04,.02
440 DATA .03,.1,.05,.05,.11,.05,.05,.01,.04,.02
445 DATA .03,.1,.05,.05,.11,.05,.05,.01,.04,.02
450 DATA .03,.1,.05,.05,.11,.05,.05,.01,.04,.02
455 DATA .03,.1,.05,.05,.11,.05,.05,.01,.04,.02
460 DATA .03,.1,.05,.05,.11,.05,.05,.01,.04,.02
465 DATA .03,.1,.05,.05,.11,.05,.05,.01,.04,.02
480 IF K>1 THEN VA(I,K)=VA(I,K-1)*(1+GVA(I,K-1))
490 NEXT I @ NEXT K
495 ! -------------------------TABLEAUX TYPES DE MORTALITE---------------------
---------------------------------- (NE PAS CHANGER)-------------------------
500 FOR I=1 TO 17 @ READ EM(I),EF(I)@ NEXT I
510 DATA 34.9,37.5,37.3,40,39.7,42.5,42.1,45,44.5,47.5,47.1,50,49.6,52.5,51.8,55
,54.1,57.5,56.5,60
520 DATA 58.8,62.5,61.5,65,63.6,67.5,66,70,68.5,72.5,71.2,75,73.9,77.5
530 FOR J=1 TO 17 @ FOR I=1 TO 34 @ READ CC(I,J)
540 NEXT I @ NEXT J
```

Table I

STRTYR	Initial year of calculations
LYEAR	Maximum number of periods to be calculated
IPP	Year in which population file will be created for future use
*EO (1,K)	Male life expectancy, period K
*EO (2,K)	Female life expectancy, period K
*FR (I,K)	Fertility rate in Region I, Period K (I=1: Rural, 2: Urban, 3: Nomad)
*FLFPR (K)	Female labor force participation rate, period K
*ABR (J,K)	Probability of livestock type J in period K having a live birth (J=1: cattle, 2: sheep, 3: camels, 4: goats)
VA (I,1)	Value added for sector I in Period 1. (I=1: Agriculture, 2: Mining/water/electricity, 3: Modern Industry, 4: Traditional Industry, 5: Construction, 6: Commerce, 7: Transport, 8: Government/Finance, 9: Services, 10: other)
*GVA (I,K)	Growth rate of value added in sector I during period K

EM (I)	Male life expectancy at level I in Model Life Tables
EF (I)	Female life expectancy at level I in Model Life Tables
CC (J,I)	Probability of surviving from age J to J + 1 at life expectancy level I
F1 (I)	Fertility rate at level I in Model Fertility Table
DC (I)	Fertility rate per 1000 women in age group I at various Model fertility levels.
*RN (K)	Rainfall during period K (beginning with period STRTYR-2)
UP (S,A)	Urban population, sex S, age A, period 1 (S=1: female, 2: male, A=1: age 0, 2: age 1, etc.)
RP (S,A)	Rural population, sex S, age A, period 1 (S=1: female, 2: male, A=1: age 0, 2: age 1 etc.)
NP (S,A)	Nomad population, sex S, age A, period 1 (S=1: female, 2: male, A=1: age 0, 2: age 1 etc.)
MIG1 (J,I)	Probability that resident age 15-35 of location J will migrate to location I (I=1; urban 3: rural 3: nomad)
AMIG1 (J,I)	Probability that resident of location J (15 age 35) will migrate to location I

PP (REG,S)	Proportion of population in region REG, SEX S who are not moderately active (used to calculate calories required)
A (REG,S)	Index of adjustment for activity level of population which is not moderately active in region REG, SEX S
RQ (K,S)	Coefficient of energy requirements, sex S, age group K
G (J)	Grams per calorie of food type J
WT (REG,S)	Average weight (in Kg) of adult, sex S, region REG
RT (REG,J)	Proportion of total calories derived from food type J in region REG
COEFF (J)	Service ratio of population per public health official (J-1: doctors, 2: dentists 3: government nurses, 4: modern midwives, 5: drugists, 6: sanitary inspectors, 7: private nurses, 8: dental technicians, 9: technical midwives
H (J)	Herdsize of livestock type J, period one
AF (J)	Proportion of livestock type J which are female
CT (J)	"Off-take" rate of livestock type J
LT (J)	Litres of milk per year per female of livestock J

STR (K)	Student teacher ratio, education Level K (k=1; ecole fondamentale, 2: secondaire generale, 3: college technique, 4: lycee technique)
SCR (K)	Student classroom ratio, educational level K
GX (J)	Amount by which the enrollment rate changes each year (J=1: ecale fundamentale both sexes; J=2: ecale secondaire generale, female; J=3: ecale secondaire technique, male)
E1 (C,S)	Enrolment in ecole fondamentale, level C, sex S, period 1
R1 (C)	Repeat rates for ecole fondamentale, level C
R2 (C)	Repeat rates for secondaire generale, level C
R3 (C)	Repeat rates for secondaire technique, level C
PSI (C)	Dropout rate for ecole fondamentale, level C
PSI 2 (C)	Dropout rate for secondaire generale, level C
PSI3 (C)	Dropout rate for secondaire technique, level C

LBRF (J)	Proportion of total labor force in period one with education level J=1: No education, 2: Traditional, 3: ecole fondamentale, 4: secondaire generale 1st cycle, 5: secondaire generale - 2nd cycle, 6: BAC technique)
WT2 (J)	Average weight (in Kg) of animal type J
YLD (J)	Average yield (proportion of total weight) which is meat, animal type J.